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SOME EFFECTS OF COMPETITION ON THE SURVIVAL OF YELLOW-POPLAR SEEDLINGS

In the upper Coastal Plain and northward in New Jersey, yellow-poplar is an important component of the hardwood forests because of its rapid growth, straight and clear bole, and desirable wood characteristics. But attempts to reproduce this species naturally after harvest cuttings have often been unsuccessful. Though poor seed crops and unfavorable seedbed conditions may at times restrict germination, observations indicate that mortality of seedlings after germination is of greater significance.

In this area, yellow-poplar is intolerant of competition for light and moisture: it requires more light than that normally reaching the ground through an intact tree canopy. Thus there is never much yellow-poplar reproduction present before cutting. Whenever seedlings do germinate under the canopy, they usually die early in life; some degree of cutting of the overstory is necessary for their survival.

But removal of the overstory also stimulates the growth of pre-existing understory vegetation. Often a dense, tall shrub thicket develops, and many years may elapse before trees penetrate it. And those that do penetrate it usually are of the most tolerant, less desirable species. In the absence of shrubs, herbaceous plants may dominate the understory; or in rare instances there may be little understory vegetation.

To determine the effects of these understory vegetation types on yellow-poplar seedling survival, and to compare the effects of two different intensities of canopy removal, a small study was started in the fall of 1958 in southern New Jersey.

Study Methods

A number of plots were located under (1) uncut stands, with nearly complete canopies; (2) shelterwood-cut stands, with about 50-percent canopies; and (3) clearcut stands, with hardly any canopy. For all samples in the last two classes, cutting had been done during the preceding year.

Within cutover areas the plots sampled three understory types: (1) 60- to 90-percent cover of herbs, or (2) of shrubs,[1] and (3) little or no cover of herbs and shrubs. Under uncut stands, plots were located only where the herb and shrub cover was sparse or nonexistent.

Each plot consisted of 10 seedlings that had started from seed the previous spring. Because of variations in seedling distribution, the plots were irregular in size and shape. Stakes were used to mark plot corners. The location of each seedling was marked by a wire pin. Two sizes of seedlings were recognized: 2 or more inches tall, and less than 2 inches tall. The two sizes were differentiated by use of pins bent in two distinctive shapes.

Originally, many such plots were established; but because of vandalism and losses from other sources, only 72 plots remained at the end of the study. Forty-four plots remained in the clearcut areas, 20 in the shelterwood-cut areas, and 8 in the undisturbed areas. This distribution does not allow effective use of statistical analysis, so only the means for the various treatments are presented. Within the two types of cutting, however, the plots were about equally distributed among the three understory conditions.

Distribution of seedlings in the two size classes varied with overstory conditions, too, but apparently was not affected by the understory classes. Under uncut stands only a few seedlings were taller than 2 inches. The proportion of such seedlings was greatest in the clearcut areas, but only slightly more than in the shelterwood-cut stands.

Plots were tallied when established in the fall of 1958, and again in the falls of 1959 and 1960. Unmarked seedlings found in 1959 and 1960 also were tallied; most of these had started after 1958.

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[1]The common shrubs included sweet pepperbush (*Clethra alnifolia*), blackberries (*Rubus* spp.), spicebush (*Lindera benzoin*), black-haw (*Viburnum prunifolium*), maple-leaved viburnum (*V. acerifolium*), southern arrowwood (*V. dentatum*), flowering dogwood (*Cornus florida*), azaleas (*Rhododendron* spp.), and low-bush blueberries (*Vaccinium* spp.), with some scattered vines of Japanese honeysuckle (*Lonicera japonica*). Common herbs were jewelweed (*Impatiens capensis*), pokeweed (*Phytolacca americana*), Solomon's-seal (*Polygonatum biflorum*), false Solomon's-seal (*Smilacina racemosa*), trillium (*Trillium* spp.), May-apple (*Podophyllum peltatum*), and jack-in-the-pulpit (*Arisaema* spp.)

Results

Undisturbed stands provided the poorest conditions for survival of the yellow-poplar seedlings. All marked seedlings in those stands died within 2 years.

Surprisingly, survival differed little between the shelterwood and clearcut areas. In shrubby understories, but not elsewhere, survival in the fall of 1959 was somewhat better on clearcut areas; this difference faded to insignificance by the fall of 1960 (table 1).

Seedling mortality was greater in shrub understories than in herb understories. The difference was slower to develop in clearcut areas than in shelterwood-cut stands (table 1), but was apparent in both when the seedlings were 3 years old.

Herb understories had little effect on seedling survival during the first 2 years, but their effect became more marked in the third year: by the fall of 1960 about a third fewer seedlings were still living in herbaceous cover than where the cover was sparse.

Table 1—*Survival of 1958 yellow-poplar seedlings as affected by overstory and understory conditions, in percent*

Understory	Undisturbed overstory		Shelterwood-cut overstory		Clearcut areas	
	October 1959	October 1960	October 1959	October 1960	October 1959	October 1960
Little or none	17	0	30	24	35	25
Herb	—	—	37	16	31	16
Shrub	—	—	16	7	30	9

Nearly all seedlings that were less than 2 inches tall at the end of their first growing season soon died. Only 19 percent survived their first winter, and most of these were dead by the following fall.

In 1959, sixty new seedlings started in the plots, 44 of them in clearcut areas. By the fall of 1960, only 18 percent of these seedlings still were alive. At that time nearly all the surviving seedlings in the plots were of 1958 origin; that is, they had started just after the logging was done. Only 1.7 percent were of 1959 or 1960 origin.

Damage by wildlife, especially rabbits, was observed each year on about 10 percent of the living seedlings. However, its effect on seedling mortality was not determined.

Summary and Conclusions

Yellow-poplar seedlings starting under three overstory and three understory conditions were marked in the fall of their first year and were observed through the next two growing seasons. Survival data were obtained on 72 plots of 10 trees each.

All marked seedlings under uncut stands died during the 2-year observation period. Survivals did not differ significantly between clearcut and shelterwood-cut areas. Under both degrees of cutting about 25 percent of the marked seedlings survived where the understory was sparse. In herbaceous understories, 16 percent of the seedlings still were alive after 2 years, and in shrubby understories about 8 percent. Regardless of overstory and understory conditions, most of the original marked seedlings that were less than 2 inches tall, and most later seedlings—those starting a year or more after the cutting—soon died.

Thus, to generalize, our observations indicate that:

- At least through their first 3 years, yellow-poplar seedlings survive about as well under a 50-percent overstory as in clearcut areas, but will not survive at all under uncut stands.
- Understory vegetation is detrimental to survival, and shrubs are more detrimental than herbs.
- To survive in any appreciable numbers, seedlings must start during the first year after cutting and must attain heights greater than 2 inches during their first growing season.

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